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WATER-RESOURCES INVESTIGATIONS IN TEXAS FISCAL YEAR 1976

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Austin, Texas

January 1976

Reproduced by the Texas Water Development Board as a part of the continuing program of cooperation in water-resources investigations between the Board and the U.S. Geological Survey.

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WATER-RESOURCES INVESTIGATIONS IN TEXAS

FISCAL YEAR 1976

INTRODUCTION

Water-resources investigations in Texas (see enclosed map) consist of the collection of basic records through the hydrologic-data network, interpretive studies, and research projects. The basic-data records and the results of investigations are published by the Geological Survey or by cooperating agencies. This report describes the water-resources projects and activities of the Geological Survey in Texas for the 1976 fiscal year (July 1, 1975, to September 30, 1976).

The Geological Survey's investigations of the water resources of Texas are under the general direction of I. D. Yost, District Chief. The Texas District office is in the Federal Building, 300 East Eighth Street, Austin, Texas 78701.

Copies of unpublished records, copies of basic data prior to publication, and copies of other unpublished records may be obtained from the District office by request.

Information regarding provisional records of stream discharge prior to publication and other hydrologic data collected within their respective areas may be obtained from the subdistrict offices in Austin, Fort Worth, Houston, San Angelo, San Antonio, and Wichita Falls. Requests for information should be addressed as follows:

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U.S. Geological Survey, WRD
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Fort Worth, TX 76115

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San Angelo, TX 76901

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Suite 234, North Plaza
San Antonio, TX 78216

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Wichita Falls, TX 76301

COLLECTION OF BASIC HYDROLOGIC DATA

A continuing series of measurements and analyses are made of streamflow, reservoir contents, and estuarine flow. In addition, data are collected on the chemical quality of water, sediment in streams and reservoirs, water levels in wells, and land-surface subsidence.

Modern computer techniques are being successfully used to collect, compute, and disseminate basic water data. By the end of the 1976 fiscal year, the following installations will be in operation: Approximately 450 digital recorders at stream-gaging, tide-level, and rainfall stations; 29 conductivity (digital) recorders; and 1 instrument for continuously monitoring and recording the water-quality characteristics of conductivity, water temperature, dissolved oxygen, and pH. The use of electronic data-processing techniques for the storage and retrieval of water records will continue to be expanded.

Surface-Water Records

Continunous-Record Streamflow Stations

As of June 30, 1975, 568 stream-gaging, reservoir-content, and stage-only stations were in operation. During the 1976 fiscal year, 13 stream-gaging, 1 reservoir-content, and 5 stage stations will be established; and 10 stream-gaging, 2 reservoir-content, and 1 stage stations will be discontinued. At the end of the 1976 fiscal year, 574 continuous-record stations will be in operation.

Partial-Record Streamflow Stations

Low-flow partial-record stations.--As of June 30, 1975, 144 low-flow partial-record stations were in operation. During the 1976 fiscal year, 11 stations are scheduled to be established and 12 stations will be discontinued.

Crest-stage partial-record stations.--As of June 30, 1975, four crest-stage partial-record stations were in operation. No additional stations are scheduled to be established during the 1976 fiscal year. Two stations are scheduled to be discontinued.

Flood-hydrograph partial-record stations.--As of June 30, 1975, 52 flood-hydrograph partial-record stations were in operation. Eight stations are scheduled to be established during the 1976 fiscal year.

Flood-profile partial-record stations.--As of June 30, 1975, eight flood-profile partial-record stations were in operation, with six additional stations scheduled to be established during the 1976 fiscal year.

Tide-level stations.--As of June 30, 1975, 58 tide-level stations were in operation. During the 1976 fiscal year, four additional stations are scheduled to be established. Five stations are scheduled to be discontinued.

Continuous Water-Quality Stations

As of June 30, 1975, 1 multiparameter water-quality monitor and 29 conductivity recorders were in operation. No additional conductivity recorders will be established during the 1976 fiscal year. The water-quality monitor is located on the Trinity River, and the conductivity recorders are located at stations in the Red, Neches, Brazos, Colorado, and Guadalupe River basins. Six multiparameter water-quality monitors are being considered for installation in the Trinity River basin during the 1976 fiscal year.

Daily Water-Quality Stations

Daily chemical-quality stations.--As of June 30, 1975, 118 daily chemical-quality stations were in operation. Sufficient samples were collected at these stations to define the total daily chemical loads. No new stations will be established during the 1976 fiscal year.

Daily suspended-sediment stations.--As of June 30, 1975, six daily suspended-sediment stations were in operation. Two of these stations were scheduled to be discontinued on October 1, 1975. No additional stations are scheduled to be established.

Periodic Water-Quality Stations

Periodic chemical-quality stations.--As of June 30, 1975, the periodic chemical-quality network consisted of stations at 76 sites on streams and stations at 53 sites on reservoirs. During the 1976 fiscal year, only minor changes will be made in this network.

Special periodic water-quality sampling sites.--Special periodic sampling will be done during the 1976 fiscal year at 172 stations. The analyses will include determinations of standard chemical quality, BOD (biochemical-oxygen demand), DO (dissolved oxygen), NO_3 (nitrate), PO_4 (phosphate), pH, pesticides in unfiltered water samples and bottom deposits, and minor elements.

Periodic suspended-sediment stations.--The periodic suspended-sediment station network was established in 1966, and as of June 30, 1975, 35 stations were in operation. During the 1976 fiscal year, data collection will be discontinued at these stations and a report will be prepared summarizing all data previously collected.

Lake and Reservoir Studies

The program for the 1976 fiscal year provides for four water-quality surveys of Town Lake (Austin); two surveys of Livingston Reservoir; and three surveys each of Lake Meredith, Lake O' the Pines, Sam Rayburn Reservoir, Lake Arlington, Lewisville Lake, Lake Conroe, Hubbard Creek Reservoir, Possum Kingdom Reservoir, Lake Granbury, Whitney Lake, Belton Lake, Somerville Lake, Canyon Lake, and Lake Corpus Christi. On-site determinations will be made of specific conductance, dissolved oxygen, temperature, and pH. Samples will be collected for laboratory analysis during each survey.

Summary of Scheduled Changes in Data Stations

Type of record: Bp--periodic biologic; D--streamflow; F--flood-profile partial record; G--stage only; H--flood-hydrograph partial record; L--low-flow partial record; Op--periodic organic water quality; P--periodic pesticide; Qp--periodic chemical quality; R--reservoir content

New Stations to be Established

Name of station	Type of record	Cooperation with USGS	Purpose of station and remarks
07314900 Little Wichita River above Henrietta, Tex.	D	City of Wichita Falls through the Texas Water Development Board	To provide assistance in managing and metering releases from Lake Arrowhead.
07343460 Lake Sulphur Springs near Sulphur Springs, Tex.	Qp	Texas Water Development Board	Reconnaissance sampling program.
08031180 Neches River near Chandler, Tex.	LQpOp	do	To be used as a water-quality control for Lake Palestine.
08042545 Galveston Bay near Marsh Point near Gilchrist, Tex.	G	Corps of Engineers, Galveston	To sample high tide in this estuary.
08048800 Big Fossil Creek at Haltom City, Tex.	G	Corps of Engineers, Fort Worth	Converted from streamflow to stage only.
08057442 Prairie Creek at Jennie Lee Street, Dallas, Tex.	H	City of Dallas	To study the effects of urbanization.
08057445 Prairie Creek at U.S. Highway 175, Dallas, Tex.	D	do	do
08057447 Hattfields Branch at Seagoville Road, Dallas, Tex.	H	do	do
08058900 East Fork Trinity River at McKinney, Tex.	D	Corps of Engineers, Fort Worth	To provide assistance in managing and metering inflows to Lake Lavon.
08059400 Sister Grove Creek near Blue Ridge, Tex.	D	do	do
08067305 Galveston Bay near Hannah's Reef near Crystal Beach, Tex.	G	Corps of Engineers, Galveston	To sample high tide in this estuary.
08067310 Galveston Bay near Crystal Beach, Tex.	G	do	do
08068438 Swale No. 8 at Woodlands, Tex.	D	The Woodlands Development Corporation through the Texas Water Development Board	To study the effects of urbanization.
08068440 Lake Harrison at Woodlands, Tex.	R	do	do
08068700 Cypress Creek at Sharp Road near Hockley, Tex.	D	Corps of Engineers, Galveston	To provide assistance in managing and metering inflows to Addicks Reservoir.

New Stations to be Established--Continued

Name of station	Type of record	Cooperation with USGS	Purpose of station and remarks
08068720 Cypress Creek at Katy-Hockley Road near Houston, Tex.	D	Corps of Engineers, Galveston	To provide assistance in managing and metering inflows to Addicks Reservoir.
08068740 Cypress Creek at House and Hall Road near Cypress, Tex.	D	do	do
08093100 Brazos River near Aquilla, Tex.	D	Corps of Engineers, Fort Worth	To provide assistance in managing and metering releases from Lake Whitney.
08110325 Navasota River above Groesbeck, Tex.	L	Brazos River Authority through the Texas Water Development Board	Records needed to define the total streamflow or chemical loads at a proposed dam site.
08110430 Big Creek near Freestone, Tex.	L	do	do
08110460 Navasota River near Marquez, Tex.	L	do	do
08118500 Bull Creek near Ira, Tex.	LQp	Corps of Engineers, Fort Worth	To determine the chloride loads and sources of chloride in this basin.
08119000 Bluff Creek near Ira, Tex.	LQp	do	do
08119100 Bluff Creek at mouth near Ira, Tex.	LQp	do	do
08142000 Hords Creek at Coleman, Tex.	G	Texas Water Development Board	Converted to stage only.
08154510 Colorado River below Mansfield Dam at Austin, Tex.	D	City of Austin	To study the effects of urbanization.
08154950 Bee Creek at Wild Basin Street, Austin, Tex.	H	do	do
08155505 Barton Creek below Barton Springs at Austin, Tex.	LQpOpPBp	do	do
08155550 West Bouldin Creek at Riverside Drive, Austin, Tex.	H	do	do
08157900 Town Lake at Austin, Tex.	QpOpPBp	do	do
08158130 Wells Branch at Parmer Lane near Austin, Tex.	H	do	do
08158880 Boggy Creek (South) at U.S. Highway 81, Austin, Tex.	H	do	do
08159000 Onion Creek at U.S. Highway 183 near Austin, Tex.	D	do	do

New Stations to be Established--Continued

Name of station	Type of record	Cooperation with USGS	Purpose of station and remarks
08159100 Onion Creek below Del Valle; Tex.	LQpOpPBp	City of Austin	To study the effects of urbanization.
08159200 Colorado River at Bastrop, Tex.	D	Lower Colorado River Authority through the Texas Water Development Board	To aid in the water management in the Colorado River basin.
08164495 Sandy Creek near Ganado, Tex.	LQpOpP	Texas Water Development Board	Records are needed to define the total streamflow and chemical loads at a proposed dam site.
08164505 Mustang Creek near Ganado, Tex.	LQpOpP	do	do
08177900 San Antonio River at Navarro Street, San Antonio, Tex.	F	Texas Water Development Board	To study the effects of urbanization.
08178640 West Elm Creek at San Antonio, Tex.	HQpOpPBp	Edwards Underground Water District through the Texas Water Development Board	To provide data on ground water - surface water interchange and to study the effects of urbanization.
08178645 East Elm Creek at San Antonio, Tex.	HQpOpPBp	do	do
08178720 Salado Creek at Rittman Road, San Antonio, Tex.	F	Texas Water Development Board	To study the effects of urbanization.
08178740 Salado Creek at East Houston Street, San Antonio, Tex.	F	do	do
08178760 Salado Creek at U.S. Highway 87, San Antonio, Tex.	F	do	do
08178780 Salado Creek at Southcross Boulevard, San Antonio, Tex.	F	do	do
08433000 Barrilla Creek near Balmorhea, Tex.	D	do	Station is needed to define the hydrologic characteristics in this area.

Type of record: C--crest-stage partial record; D--streamflow; G--stage only; H--flood-hydrograph partial record; L--low-flow partial record; Op--periodic organic water quality; Q--daily chemical quality; Qp--periodic chemical quality; R--reservoir content; Sp--periodic sediment

Stations to be Discontinued

Name of station	Type of record	Cooperation with USGS	Reason for discontinuance
07316230 Sandy Creek near Sadler, Tex.	LQp	Texas Water Development Board	Sufficient data and samples have been collected to satisfy the project objectives.
07343480 White Oak Creek near Mount Vernon, Tex.	LQp	do	do
08018750 Williams Creek near Alba, Tex.	C	Texas Department of Highways and Public Transportation	Sufficient data have been collected to satisfy the project objectives.
08037330 Angelina River near Etoile, Tex.	LQpOp	Corps of Engineers, Fort Worth	Sufficient data and samples have been collected to satisfy the project objectives.
08038100 Attoyac Bayou near Etoile, Tex.	QpOp	do	Sufficient samples have been collected to satisfy the project objectives.
08038490 Sam Rayburn Reservoir at State Highway 147 near Zavalla, Tex.	QpOp	do	do
08046000 Clear Fork Trinity River near Aledo, Tex.	D	do	Sufficient data have been collected to satisfy the project objectives.
08059000 East Fork Trinity River near McKinney, Tex.	D	Corps of Engineers, Fort Worth and the Texas Water Development Board	do
08059500 Sister Grove Creek near Princeton, Tex.	D	do	Station is in backwater, therefore reliable results cannot be obtained at this site.
08066147 White Rock Creek at Farm Road 356 near Trinity, Tex.	LQp	Trinity River Authority through the Texas Water Development Board	Sufficient data and samples have been collected to satisfy the project objectives.
08086015 Hubbard Creek near Sedwick, Tex.	LQp	West Central Texas Municipal Water District through the Texas Water Development Board	do
08086020 Hubbard Creek at U.S. Highway 380 near Moran, Tex.	LQp	do	do
08086050 Deep Creek at Moran, Tex.	DQ	do	do
08086100 Hubbard Creek near Albany, Tex.	DQSp	do	do
08086120 Salt Prong Hubbard Creek at U.S. Highway 380 near Albany, Tex.	LQp	do	do
08086130 Cook Creek near Albany, Tex.	LQp	do	do

Stations to be Discontinued--Continued

Name of station	Type of record	Cooperation with USGS	Reason for discontinuance
08086200 Salt Prong Hubbard Creek near Albany, Tex.	LQp	West Central Texas Municipal Water District through the Texas Water Development Board	Sufficient data and samples have been collected to satisfy the project objectives.
08086210 Snailum Creek near Albany, Tex.	LQp	do	do
08086220 Big Sandy Creek near Eolian, Tex.	LQp	do	do
08086235 Battle Creek near Moran, Tex.	LQp	do	do
08086260 Pecan Creek near Eolian, Tex.	DQ	do	do
08091150 South Paluxy River near Stephenville, Tex.	C	Texas Department of Highways and Public Transportation	Sufficient data have been collected to satisfy the project objectives.
08093000 Brazos River near Whitney, Tex.	D	Corps of Engineers, Fort Worth	Station discontinued because no easement could be obtained.
08096800 Cow Bayou subwatershed No. 4 near Bruceville, Tex.	D	Texas Water Development Board	Sufficient data have been collected to satisfy the project objectives.
08097000 Cow Bayou at Mooreville, Tex.	D	do	do
08112200 Brazos River near Wallis, Tex.	G	Houston Lighting and Power Company through the Texas Water Development Board	do
08152400 Lake Lyndon B. Johnson near Marble Falls, Tex.	Qp	Texas Water Development Board	Sufficient samples have been collected to satisfy the project objectives.
08158925 Williamson Creek tributary at Brodie Lane near Austin, Tex.	H	City of Austin	Infeasible to gage.
08159500 Colorado River at Smithville, Tex.	D	Lower Colorado River Authority through the Texas Water Development Board	Sufficient data have been collected to satisfy the project objectives.
08365540 Northgate Reservoir at El Paso, Tex.	R	City of El Paso through the Texas Water Development Board	USGS participation is no longer necessary.
08365545 Range Reservoir at El Paso, Tex.	R	do	do

Ground-Water Records

A network of wells for observing fluctuations in ground-water levels, changes in the chemical quality of ground water, and subsidence of the land surface is maintained in areas of large-scale ground-water development. The periodic collection of ground-water data can be used in solving such specific problems as over-development and its relation to pumping costs, relationship of recharge to discharge of an aquifer, and the relationship of the quality of ground water to the development and use of the water.

The observation-well network is confined to the areas of continuing ground-water studies in the Houston area, Galveston County and adjacent areas, San Antonio area and Balcones Fault Zone, El Paso area, and Orange County and adjacent areas. As of June 30, 1975, the Geological Survey was monitoring more than 1,200 wells. The types and numbers of observation wells programed for the 1976 fiscal year by areas are as follows:

Area	Water levels		Chemical quality	Subsidence
	Periodic	Continuous		
Houston area	500	6	90	7
Galveston County and adjacent areas	90	2	35	1
San Antonio area and Balcones Fault Zone	8	10	70	0
El Paso area	234	9	14	0
Orange County and adjacent areas	98	2	58	0

PROJECT STUDIES

Hydrologic Studies of Small Watersheds

The U.S. Soil Conservation Service (SCS) has an extensive program of constructing floodwater-retarding structures in small watersheds in Texas. These structures, which are designed to control floodflows and sediment movement, will have varying but important effects on the natural surface- and ground-water resources of river basins, especially where a large number are built. The need has grown for basic hydrologic data on these small watersheds to compare the hydrology under natural and developed conditions. It is, therefore, essential that the hydrologic studies determine the extent to which the floodwater-retarding structures affect the volume and mode of occurrence of runoff.

The specific objectives of these studies are:

(1) To determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points.
(2) To determine the effectiveness of the structures as ground-water recharge facilities.
(3) To determine the effect of the structures on the sediment yield at downstream points.
(4) To develop relationships between runoff and rainfall in small natural watersheds.
(5) To develop stream-system models for basins with floodwater-retarding structures.
(6) To determine the minimum instrumentation necessary for estimating the flood hydrographs below a system of structures, as needed for downstream water-management operations.

Hydrologic studies of SCS-developed areas in Texas, which were started in 1951, have been made by the Geological Survey in 12 small watersheds to provide the needed data for analyses. The U.S. Soil Conservation Service, Texas Water Development Board, San Antonio River Authority, city of Dallas, and the Tarrant County Water Control and Improvement District No. 1 cooperated with the Geological Survey in these studies. The 12 study areas were chosen on a statewide basis to sample watersheds having different rainfall, topography, geology, and soils. In five of the study areas, streamflow and rainfall records were collected prior to construction of the floodwater-retarding structures, thus affording the opportunity for analyses of the hydrologic conditions before and after construction.

The 12 study areas, which are in four major river basins, are North Creek, Elm Fork Trinity River, Little Elm Creek, Honey Creek, and Pin Oak Creek, all in the Trinity River basin; Green Creek, Cow Bayou, Little Pond-North Elm Creeks, in the Brazos River basin; Deep and Mukewater Creeks in the Colorado River basin; and Escondido and Calaveras Creeks in the San Antonio River basin.

The long-range plan for the small-watershed studies specified that the data-collection program in each study area be skeletonized when data were sufficient to accomplish the objectives as limited by the instrumentation in the particular study area. In keeping with this plan, data-collection programs have been skeletonized as follows: Green Creek study area in 1967; Elm Fork Trinity River and Calaveras Creek study areas in 1968; Honey Creek study area in 1969; and Escondido Creek study area in 1970.

During the 1972 fiscal year, basic-data reports, which present a compilation of the annual hydrologic data, were prepared for each study area. A reevaluation of the long-range plan led to discontinuing rain-gage networks in October 1971 in the following skeletonized study areas: Green Creek, Honey Creek, Deep Creek, Escondido Creek, and Calaveras Creek. Data collection in the North Creek study area was expanded to include five floodwater-retarding structures completed during the year.

During the 1973 fiscal year, further reductions in data collection and analysis were initiated in this project. All data collection in the Pin Oak Creek study area was discontinued October 1, 1972. The annual preparation of basic-data reports and storm analyses was discontinued for all skeletonized study areas.

Further reductions in data collection for the project were carried out in the 1975 fiscal year so that study areas remaining in the project are only those in the North Creek and Little Elm Creek watersheds. Data collection in these study areas will continue until sufficient "after-development" data have been collected to afford interpretive analyses leading to attainment of the objectives of the project. Sufficient data have been collected in the Little Elm Creek watershed to permit discontinuing data collection by the end of the 1976 fiscal year.

Urban-Hydrology Studies

Society is confronted with the most urgent water problems in urban areas, where residential, commercial, and industrial complexes may be subject to potentially destructive floods and where lives and vast sums of money can be saved if metropolitan drainage systems and water-control facilities are properly planned.

Because undeveloped land is being converted to urban use, the amount of impervious surface area is increased, which results in a change in the runoff pattern. Higher peak discharges may result. Drainage systems that were constructed prior to urbanization may need to be redesigned to function properly under conditions of ultimate land development. Because of these requirements, hydrologic data are needed to define the effects of urbanization on the magnitude of floodflow from small drainage areas. Data are also needed to define the quality of storm runoff from urban watersheds.

The Geological Survey, in cooperation with State and local agencies, is making hydrologic studies in the Austin, Dallas, Dallas County, Fort Worth, Houston, and San Antonio areas. These studies will provide data necessary for defining the changes in storm runoff resulting from progressive urban development and for defining flood boundaries and depths of inundation for floods of various magnitudes and frequencies. In the Austin, Houston, and San Antonio areas, water-quality data are obtained for studies of streamflow pollution by the urban environment.

Austin Project

The Austin project began with a very small program in 1954 in cooperation with the Texas Water Development Board. The project initially involved the collection of rainfall and runoff data in the Waller Creek basin, a 4.13-square-mile urban watershed in Austin. Collection of rainfall and runoff data was started in 1963 in the Wilbarger Creek basin, a 4.61-square-mile rural watershed 15 miles northeast of Austin. The data collected in the Wilbarger Creek area, which is comparable in size, climate, and geology to the Waller Creek study area, will be used for comparison to infer hydrologic effects of urban development.

Data are being collected from three recording rain gages and from two continuous-record stream-gaging stations in the urban watershed of Waller Creek. Three recording rain gages and one continuous-record stream-gaging station provide data for the Wilbarger Creek watershed.

During 1975, data collection in the project was expanded to include: 19 additional sites for streamflow (14 for flood hydrograph, 2 for continuous record, and 3 for periodic measurements with water-quality samples), 12 additional recording rain gages, 8 sites for water-quality sampling of streamflow, and seasonal intensive water-quality surveys of Town Lake. These additional data-collection sites are located in the Bull, Barton, Bouldin, Shoal, Boggy, Walnut, Williamson, and Onion Creeks watersheds, which are tributary to the Colorado River.

Data collection during the 1976 fiscal year will be further expanded to include five additional sites for streamflow (four for flood hydrograph and one for continuous record) and four recording rain gages in the Bull, Bee, and Onion Creeks watersheds.

Basic-data reports, which contain graphical and tabular data on the rates and volumes of rainfall and runoff from major storms, tables of daily runoff at selected sites, and tables showing the quality of the streamflow and the storage in Town Lake, will be prepared annually.

Dallas Project

The Dallas project, which began in 1961, is in cooperation with the city of Dallas. During the 1973 fiscal year, the following changes were made: Data collection at 87 flood-profile gages, 7 recording rain gages, and 1 flood-hydrograph gage was discontinued; and data collection began at 3 flood-hydrograph gages. An interpretive report "Effects of urbanization on floods in the Dallas, Texas, metropolitan area," based on data collected in the project through September 1970, was completed during fiscal year 1974.

During the 1974 fiscal year, data collection was expanded in the Fivemile Creek drainage basin by the establishment of three flood-hydrograph (dual-digital) type stations and two weighing-type rainfall stations. Collection of rainfall and flood-stage or discharge data was also continued at 6 continuous-record stream-gaging stations, 13 flood-hydrograph stations, 2 flood-profile stations, and 29 recording rain-gage stations (including 9 gages at partial-record stations). This extensive hydrologic network covers the White Rock Creek, Turtle Creek, Bachman Branch, Joes Creek, Fivemile Creek, Cedar Creek, and Coombs Creek watersheds in Dallas.

Data collection during the 1976 fiscal year will be expanded to include the Prairie Creek drainage basin. One continuous-record stream-gaging, two flood-hydrograph (dual-digital), and two weighing-type rainfall stations will be established. Basic-data reports, presenting graphical and tabular data for rates and volumes of rainfall and runoff for selected storms during the year, will continue to be prepared annually.

Dallas County Project

The Dallas County urban hydrology study was initiated during the 1969 fiscal year in cooperation with the Dallas County Department of Public Works. The study area constitutes all of Dallas County exclusive of the city of Dallas and contains many rapidly urbanizing communities.

The initial data-collection network consisted of 1 continuous-record streamflow, 2 flood-hydrograph (dual-digital), 6 weighing-type rainfall, and 21 flood-profile crest-stage stations. These stations were located in the Duck and South Mesquite Creeks watersheds.

During the 1970 fiscal year, the network was expanded by instrumenting Tenmile Creek watershed with one continuous-record streamflow station, eight flood-profile crest-stage gages, and five weighing-type rain gages and by adding a streamflow station and three flood-profile crest-stage stations in the Duck Creek watershed.

Data collection during the 1976 fiscal year will continue at about the same level as in 1975. Data collected in this project are included with that published annually for the Dallas project.

Fort Worth Project

The Fort Worth project was initiated during the 1969 fiscal year in cooperation with the city of Fort Worth. The data-collection network now consists of 5 continuous-record streamflow, 2 flood-hydrograph, 10 weighing-type rainfall, and 43 crest-stage flood-profile stations. These stations are located in the Little Fossil Creek, Dry Branch, and Sycamore Creek watersheds.

During 1970, the data-collection network was expanded by the addition of three continuous-record streamflow stations and four recording rain gages in the Sycamore Creek watershed and a special study area (Seminary South Shopping Center). During the 1971 fiscal year, 16 crest-stage flood-profile stations were added in the Sycamore Creek watershed.

Data collection during the 1976 fiscal year will continue at about the same level as in 1975. Basic-data reports will be published annually.

Houston Project

The Houston project, which began in 1964, is in cooperation with the city of Houston and the Texas Water Development Board. The data-collection network initially consisted of 7 continuous-record stream-gaging stations, 17 flood-hydrograph partial-record stations (each having recording rain gages), and 5 weighing-type recording rain gages.

The program was expanded during the 1969 fiscal year to include collection of water-quality data on the chemical quality, nutrients, BOD, pesticides, and sediment at five sites. During the 1972 fiscal year, periodic chemical-quality samples were collected at 6 additional sites, and samples for coliform counts and minor-element analyses were collected at 17 sites. The program was also expanded in 1972 to include collection of streamflow quality and quantity data before development of a planned "satellite town" in the Panther Branch drainage basin about 25 miles north of Houston.

Program changes in fiscal year 1973 included discontinuing 9 of the 17 flood-hydrograph partial-record stations, installing 8 additional weighing-type recording rain gages, and collecting additional samples for water-quality studies. Data collected in the project through September 1969 afforded analyses that resulted in a report "Effects of urbanization on floods in the Houston, Texas, metropolitan area" published in April 1973.

During the 1976 fiscal year, data collection in Houston proper will continue at about the same level as in 1975. However, water-quality data collection in the Panther Branch drainage basin will be reduced to collection of sediment data at a single site.

Basic-data reports, presenting graphical and tabular data for rates and volumes of rainfall and runoff each year and the quality of the streamflow will continue to be prepared annually.

San Antonio Project

The San Antonio project was initiated in 1968 in cooperation with the Texas Water Development Board. The data-collection network now consists of three continuous-record streamflow, four flood-profile, six flood-hydrograph (dual-digital), and nine recording rainfall stations.

The data-collection program was expanded during the 1969 fiscal year to include samples collected and analyzed periodically from 11 streamflow sites. Results of these analyses will be included in the annual basic-data reports. Analyses scheduled are: Standard chemical; nutrients; BOD; pesticides; and sediment. The program for 1971 was expanded slightly by the addition of a sediment station at Olmos Creek at Dresden Drive. In 1972, the gaging station at Olmos Reservoir was discontinued.

Data collection during the 1976 fiscal year will continue at about the same level as in 1975. Basic-data reports presenting graphical and tabular data for rates and volumes of rainfall and runoff each year and the quality of the streamflow, will continue to be published annually.

Flood Stages and Discharges for Small Streams in Texas (Highway Program)

The highway program, which began in 1965, is in cooperation with the Texas Department of Highways and Public Transportation and the U.S. Department of Transportation, Federal Highway Administration. The objective of the project is to define the frequency and magnitude of floods on small rural watersheds having drainage areas of less than 20 square miles. This information is needed to establish criteria for properly designing culverts and bridges on highways. Toward this end, 150 crest-stage partial-record stations have been established throughout Texas. Data on flood magnitudes and volumes and on rainfall amounts and intensities are being obtained at each station.

The first report--a compilation of all peak-discharge data collected in Texas through September 30, 1963, for streams draining about 100 square miles or less--was printed in 1966. This report, entitled "Floods on small streams in Texas" was released in January 1966 as a U.S. Geological Survey open-file report. Eight additional reports containing data for water years 1964-72 have been completed.

During the 1974 fiscal year, a report entitled "Estimating the magnitude of peak discharges for selected flood frequencies on small streams in East Texas" was prepared and distributed as an open-file report. The report contains regression equations for the computation of peak discharges at ungaged sites on small streams generally east of the 98th meridian.

During the 1975 fiscal year, all data collection under this project was suspended September 30, 1974. Funds heretofore used for data collection will be used in data analyses aimed at statewide definition of flood characteristics. Completion of analyses and preparation of an appropriate report is scheduled during the 1976 fiscal year.

Chemical and Physical Characteristics of Water in Bays and Estuaries of Texas

This study, begun in October 1967, is in cooperation with the Texas Water Development Board. The objectives of the study are to collect data on water temperature, pH, dissolved constituents, concentration of nutrients (phosphorus and nitrogen compounds), minor elements, water velocities and directions, and other data necessary to define the source and distribution of nutrients, current patterns and rates of movement, and the physical and organic water quality in areal distribution and time variation.

Five water-quality surveys of the Sabine-Neches, Lavaca-Tres Palacios, Guadalupe, Mission-Aransas, and Nueces estuaries and three water-quality surveys of the Brazos, East Matagorda, Colorado, and Laguna Madre estuaries are made annually.

Special investigations to determine the quantity and quality of fresh-water inflow and the exchange of water between the Sabine-Neches estuary and the Gulf of Mexico were made during fiscal year 1975.

To supplement available tide-stage records being obtained by the U.S. Army Corps of Engineers and U.S. Geological Survey, 21 tide-stage gages funded by the Corps of Engineers are operated by the Geological Survey. Thirty-seven additional tide and/or estuary stage gages are operated as part of the cooperative program with the Texas Water Development Board.

The basic data will be released to interested agencies on as timely a basis as possible and will be released in an annual basic-data compilation. Interpretive reports will be prepared as the data warrant.

Pesticides Program

The Geological Survey collects, at quarterly intervals, samples for pesticides analyses from a network of stations on streams throughout the western states. Fifteen stations in Texas are included in the network.

Programs in cooperation with the Texas Water Development Board provide for studies of the quantities of chlorinated hydrocarbon pesticides in water and bottom sediments at a network of surface-water stations, in runoff in the Austin, Houston, and San Antonio urban areas, and in selected wells in counties where ground-water studies are in progress.

Continuing Ground-Water Studies

The continuing ground-water studies are detailed studies that are designed to keep abreast of and to evaluate the effects of large withdrawals of ground water in the areas of concentrated pumping. The need for ground-water information in these areas is determined by the particular problems of the area, and the programs of continuing study are carefully planned to meet specific objectives.

Houston Area

The ground-water study in the Houston area, which began on a more or less continuous basis in 1929, is in cooperation with the Texas Water Development Board and the city of Houston. The program proposed for 1976 is a continuation of basic-data collection. Items of work will include an inventory of all new large-capacity wells; periodic measurements of water levels in about 500 observation wells; operation and maintenance of 6 continuous water-level recorders and 7 compaction recorders; collection of water samples annually from about 90 wells for chemical analyses; conducting pumping tests on new large-capacity wells; an inventory of annual municipal, industrial, and irrigation pumpage; and the preparation of specifications for drilling holes to monitor subsidence. A progress report will be prepared during fiscal year 1976.

Galveston County

The ground-water study in Galveston County, which began in 1931, is in cooperation with the Texas Water Development Board and the city of Galveston. The program consists of a compilation and tabulation of records of water-level fluctuations, changes in water quality, pumpage, and land-surface subsidence. For 1976, the program consists of semi-annual measurements of water levels in 90 observation wells, operation and maintenance of 2 continuous water-level recorders and 1 compaction recorder, observation of the chemical quality of water annually in 35 wells, inventory of all municipal and industrial pumpage, and observance of the effects of land-surface subsidence. A progress report will be prepared during fiscal year 1976.

El Paso Area

The ground-water study in the El Paso area began in 1935 in cooperation with the Texas Water Development Board and the city of El Paso. The program for the 1976 fiscal year is in two parts. The first part of the program consists of a continuation of the collection of basic hydrologic data in the Hueco Bolson and Mesilla Valley; measuring about 200 wells annually, 30 quarterly, 4 monthly, and 9 continuously with water-level recorders; inventorying all new wells (excluding shallow irrigation wells); making aquifer tests in large-capacity wells; and collecting water samples from about 14 wells.

The second part of the program consists of compiling and tabulating data for a mathematical model of the lower Mesilla Valley and making calibration runs on the model. A report completed in fiscal year 1975 will be released as a Texas Water Development Board report in 1976.

San Antonio Area and Balcones Fault Zone

The ground-water study in the San Antonio area and Balcones Fault Zone, which began in 1949, is in cooperation with the Texas Water Development Board and the Edwards Underground Water District. The objectives of the study are to appraise quantitatively the ground-water resources in the San Antonio area and along the Balcones Fault Zone from Kinney County to the Hays-Travis County line and to continue to investigate the cause and effect relationships in the Edwards aquifer.

The 1976 program consists of continuing to collect and analyze the basic geologic and hydrologic data and to refine the previous evalutions. Items of work include the periodic measurements of water levels in 8 wells; operation and maintenance of continuous water-level recorders on 10 wells; collection of water samples from 5 wells along the bad-water line for chemical analyses of inorganic elements and from 65 wells for some but not all inorganic, biologic, and minor elements and pesticides; inventory of all large-capacity well pumpage and spring discharge; inventory of new wells; and mapping of the principal recharge area of the Edwards aquifer. A basic-data report and a report discussing the extent of pollution in the aquifer will be prepared for release in fiscal year 1976.

Orange County and Adjacent Areas

The ground-water study in the Orange County area, which began in 1967, is in cooperation with the Texas Water Development Board and the Sabine River Authority of Texas. The purpose of this study is to keep abreast of the effects of ground-water development in the area and especially to monitor the fresh water - salt water interface as a guide to future development of ground water in Orange and adjacent counties to prevent further salt-water intrusion. The magnitude of industrial and municipal development in the area greatly increases the gravity of the situation.

The 1976 fiscal-year program will consist of the inventory of all new large-capacity wells, including the collection of drillers' logs, electrical logs, and well-construction information; measurements of water levels in about 98 observation wells on a semi-annual basis; operation and maintenance of two continuous water-level recorders; and the location of additional wells suitable for water-level recorders. In addition, water samples from about 58 wells are to be collected annually for chemical analysis; annual municipal and industrial pumpage is to be inventoried; and all data currently and previously collected are to be analyzed, interpreted, and correlated. A basic-data report will be prepared in 1976.

Other Interpretive Studies

Water Resources of Big Bend National Park

This study, which began in July 1966, is in cooperation with the National Park Service. The objective of the study is to determine the available sources of water for Big Bend National Park. The study has been temporarily suspended for 1976.

Artificial-Recharge Research on the High Plains of Texas and New Mexico

This research project, which began during the 1968 fiscal year, is financed wholly by Federal funds. The study will provide information needed in connection with artificial recharge of water obtained from the playa lakes or imported to the High Plains. The study is also providing the opportunity for applied research on methods of artificial recharge. During the 1976 fiscal year, recharge from the surface through spreading ponds will be continued. Additional work is being done on problems associated with recharge through wells, such as the control of sediment in recharge water. Reports on specific aspects of the recharge studies will be prepared when warranted.

Water Resources of Guadalupe Mountains National Park

This study was begun during the 1969 fiscal year in cooperation with the National Park Service. The objectives are to appraise the water resources of this newly established park. Because the present water supply of the area--obtained from wells and springs--is inadequate for anticipated needs, the study will include a complete inventory of wells and springs with particular attention to those areas of immediate need (Frijoles Ranch site, McKittrick Canyon, and the Bowl). The study has been temporarily suspended for 1976.

Hydrologic-Research Studies of the Edwards and Associated Limestones

This ground-water study is in cooperation with the Texas Water Development Board, the Edwards Underground Water District, and the San Antonio City Water Board. All indications, both past and present, indicate that the Edwards aquifer will, in time, become totally developed (in the amount of the natural recharge), and that it will then become necessary to integrate the use of water from the Edwards with water imported from other sources. At that time, it will be necessary to know in as much detail as possible how to get the most water from the Edwards with least waste, with a minimum conflict between users, and with a minimum detriment to those users who are in less favorable locations.

This study will provide for the complete appraisal of the availability of water in the Edwards aquifer, thereby furnishing valuable and detailed information not now available to all agencies that may be concerned with water management.

The program for 1976 will emphasize the analyses and interpretation of the test-well data in terms of reservoir characteristics. The program will also include: (1) Continued geophysical logging of all available holes; (2) preparation of cross sections; (3) laboratory analyses of cores; (4) a continuation of the correlation between rainfall and recharge; (5) an evaluation of streamflow records to determine recharge; (6) the collection of water samples for stable and radioactive-isotope analyses, including tritium; (7) collecting about 20 water samples primarily from along or near the bad-water line; and (8) packer testing to locate and evaluate zones of flow. Reports on results of geologic studies and the relation between rainfall and recharge will be prepared for publication during fiscal 1976.

Digital-Model Study of the Chicot and Evangeline Aquifers of the Texas Gulf Coast

The rapidly increasing demands on the ground-water resources in the Gulf Coast area has made it necessary to evaluate the major aquifers along the Gulf Coast of Texas. The ultimate product of the study will be a digital model, which will serve as a guide for the regional development and protection of the aquifers.

The study will be conducted in several phases, the first of which consists of an evaluation of the ground-water supplies in Colorado, Lavaca, and Wharton Counties. The program for 1976 includes the completion of: (1) A report on the three-county area (phase I); (2) the delineation of the aquifers and preparing representative sections for an open-file report (phase II); and (3) the selection of an appropriate model for study (phase III). Phase IV of the study will begin during the 1976 fiscal year and will involve the collection of basic data needed for the model for the eastern half of the Gulf Coast.

Rio Grande Environmental Study

The present water needs (exclusive of irrigation) of the El Paso area are supplied almost entirely from ground-water sources. The known available supplies of fresh ground water are large, but for future growth, additional sources of water need to be identified. The study will provide information on the amounts and quality of fresh and slightly saline ground water available for development in the Salt Basin, Quitman and Presidio Bolsons, Mesilla Valley, and La Mesa Bolson.

The 1976 program, in cooperation with the Texas Water Development Board, will include the preparation and completion of a final report and the modification of the Hueco Bolson digital model.

Mapping of Flood-Prone Areas

The U.S. Geological Survey is mapping flood-prone areas in Texas by delineating the outline of the 100-year flood on existing topographic maps. This program is part of a Nationwide Federal program designed to aid in reducing flood losses. In addition to the 99 quadrangles completed through June 30, 1973, within the Geological Survey program, a cooperative program was developed with the Department of Housing and Urban Development in which an additional 328 7-1/2-minute quadrangles were completed by June 30, 1973. An additional 208 quadrangles were mapped by June 30, 1974, and an additional 7 quadrangles by June 30, 1975, bringing the total of 7-1/2-minute quadrangles mapped in Texas to about 642. In addition, the Geological Survey, in cooperation with the Department of Housing and Urban Development, is making more detailed flood studies to establish actuarial rates in the populated areas within the State. A list of the completed maps is given in the section "Reports in Preparation, Released, or Published During Fiscal Year 1976."

Trinity River Time-of-Travel Study

The purpose of these studies is to provide data to the Trinity River Authority to develop a mathematical model of the water quality of the Trinity River. The model is being developed as part of a comprehensive water-quality management plan for the Trinity River basin.

Three time-of-travel studies have been completed. The results of the first two studies have been released in open-file reports. The first study, for the period July 31 to August 14, 1972, covered a reach of the West Fork Trinity River between Fort Worth and Dallas and two reaches of the main stem of the Trinity, one from Dallas to the upper end of Livingston Reservoir and the other from below Livingston Dam to Liberty. The second study, in September 1973 and July-August 1974, included parts of the West Fork Trinity River and the main stem of the Trinity River. The third study, which was made in December 1975, covered the Elm Fork Trinity River downstream from Lewisville Dam and the East Fork Trinity River downstream from Forney Dam. The results of the last study will be released in late 1976 or early 1977 fiscal year.

Salt-Water Encroachment, Houston Area

The ultimate objectives of the study, in cooperation with the city of Houston and the Texas Water Development Board, are to determine the location of the fresh water - salt water interfaces in the aquifers and to determine the rates of movement of the salt water towards centers of pumping.

The extensive development of ground water in the greater Houston area has caused movement of saline water into the fresh-water sands. Increases of chloride concentrations in fresh ground water have been measured adjacent to interfaces in Galveston and Harris Counties for many years. Salt-water contamination in shallow wells in the vicinity of the Houston Ship Channel has been reported. Recently, water from a well completed in the Chicot aquifer near the channel in the vicinity of Houston has become salty. The Chicot aquifer is the major aquifer in Galveston County and southeastern Harris County. The work in 1976 will consist of the preparation and completion of a final report.

Miocene Aquifer Study - Gulf Coast Region of Texas

The increasing demands on the ground-water resources of the Texas Gulf Coast require a more detailed evaluation of the potential of the Miocene aquifers as a source of water supply. The study will result in a digital model that will serve as a useful tool to aid water planners in the regional development of these aquifers.

The study will be made in four phases, the first beginning in 1975 and consisting of delineating the principal aquifer (Jasper and Catahoula) within the Texas Gulf Coastal region. During fiscal year 1976, a report on the results of phase I will be prepared, an appropriate model (digital or analog) will be selected, and the collection of basic data needed for the model will begin.

Sources of Saline Water in the Upper Colorado River Basin

The segment of the Colorado River between Colorado City and Lake J. B. Thomas has long been known to contain high concentrations of salt. Recent investigations suggest that controls on disposal of oil-field brine, diversion of saline water, and other remedial measures are improving the quality of water in the Colorado River. The purposes of this study, in cooperation with the U.S. Army Corps of Engineers, are to delineate the areas of saline inflow and to determine if the quantities of salt reaching the upper Colorado River are decreasing.

Drainage Area Determinations

The objective of this project is to determine the drainage areas of all major streams in Texas. After drainage-area determinations are completed, the results are compiled, by river basin, in open-file reports that will serve to eliminate the use of conflicting values. Reports have been prepared and distributed for the Sabine, Neches, San Jacinto, Trinity, Lavaca, Guadalupe, San Antonio, and Coastal basins. The report on the drainage area of the Brazos River basin will be completed during fiscal year 1976.

National Eutrophication Survey

The U.S. Geological Survey, in cooperation with the Environmental Protection Agency, furnished daily and monthly streamflow data for approximately 200 sites above and below selected reservoirs in Texas. These data, together with the analyses of water-quality samples collected (September 1974 to August 1975) by the National Guard at the same sites, provide the Environmental Protection Agency with information to determine the threat of pollution by excess nutrients (phosphorus and nitrogen) and the source of the nutrients. This program partially fulfills the goal of the Federal Water Pollution Act to protect the Nation's waters.

Basic-Data Reports

Water Resources Data for Texas

Water resources data for Texas, 1974 - Part I: Surface-water records. Records for the 1974 water year (October 1973 - September 1974), published as a U.S. Geological Survey report.

Water resources data for Texas, 1974 - Part II: Water-quality records. Records for the 1974 water year (October 1973 - September 1974), published as a U.S. Geological Survey report.

Water resources data for Texas, water year 1975 (October 1974 - September 1975), volumes 1-3 will be published as U.S. Geological Survey Water-Data report TX 75-1.

Hydrologic Studies of Small Watersheds

Hydrologic data for Cow Bayou, Brazos River basin, Texas, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Little Elm Creek, Trinity River basin, Texas, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Mountain Creek, Trinity River basin, Texas, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for Mukewater Creek, Colorado River basin, Texas, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for North Creek, Trinity River basin, Texas, 1973. Limited number of copies reproduced as a U.S. Geological Survey oepn-file report.

Hydrologic data for Cow Bayou, Brazos River basin, Texas, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for Little Elm Creek, Trinity River basin, Texas, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for Mountain Creek, Trinity River basin, Texas, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for North Creek, Trinity River basin, Texas, 1974. Limited number of copies to be reproduced by the Texas District.

Urban-Hydrology Studies

Hydrologic data for urban studies in the Austin, Texas, metropolitan area, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Dallas, Texas, metropolitan area, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Fort Worth, Texas, metropolitan area, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Houston, Texas, metropolitan area, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the San Antonio, Texas, metropolitan area, 1973. Limited number of copies reproduced as a U.S. Geological Survey open-file report.

Hydrologic data for urban studies in the Austin, Texas, metropolitan area, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Dallas, Texas, metropolitan area, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Fort Worth, Texas, metropolitan area, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the Houston, Texas, metropolitan area, 1974. Limited number of copies to be reproduced by the Texas District.

Hydrologic data for urban studies in the San Antonio, Texas, metropolitan area, 1974. Limited number of copies to be reproduced by the Texas District.

Flood Stages and Discharges for Small Streams in Texas (Highway Program)

Flood stages and discharges for small streams in Texas, 1972. This report was released as a U.S. Geological Survey open-file report (Texas Highway Department and Federal Highway Administration Research Study 4-5-65-85, Interim report 85-9).

Floods in Texas, magnitude and characteristics through the 1974 water year. This report will be released as a U.S. Geological Survey open-file report.

Water-Quality Basic-Data Reports

Chemical and physical characteristics of water in estuaries in Texas, October 1970 - September 1971. This report was published as Texas Water Development Board report 191.

Water-quality records for the Hubbard Creek watershed, Texas, October 1972-September 1974. This report was released as a U.S. Geological Survey open-file report.

Water-quality records for selected reservoirs in Texas, 1972-73 water years. This report was published as Texas Water Development Board report 194.

Chemical and bacteriological quality of water at selected sites in the San Antonio area, Texas. This report will be published as a bulletin of the Edwards Underground Water District.

Chemical and physical characteristics of water in estuaries of Texas, October 1971 - September 1973. This report will be published as a Texas Water Development Board report.

Chemical and physical characteristics of water in estuaries in Texas, October 1973 - September 1974. This report will be published as a Texas Water Development Board report.

Quality of water in Lake Livingston. This report will be released as a U.S. Geological Survey open-file report.

Summary of inflow studies of four Texas estuaries. This report will be published as a Texas Water Development Board report.

Ground-Water and Other Basic-Data Reports

Records of precipitation, water levels, and ground-water recharge to the Edwards and associated limestones, San Antonio area, Texas, 1972-73. This report was published as Edwards Underground Water District Bulletin 33.

Ground-water discharge from the Edwards and associated limestones, San Antonio area, Texas, 1974. This report was published as Edwards Underground Water District Bulletin 34.

Ground-water data for Brazoria, Fort Bend, and Waller Counties, Texas, 1966-74. This report will be published as a Texas Water Development Board report.

Ground-water data for Chambers, Liberty, and Montgomery Counties, Texas, 1966-74. This report will be published as a Texas Water Development Board report.

Ground-water data for Harris and Galveston Counties, Texas, 1970-74. This report will be published as a Texas Water Development Board report.

Ground-water data for the Orange County area, Texas and Louisiana, 1971-74. This report will be published as a Texas Water Development Board report.

Ground-water data for the Salt Basin, Eagle Flat, Red Light Draw, Green River Valley, and Presidio Bolson in westernmost Texas. This report will be released as a U.S. Geological Survey open-file report.

Ground-water discharge from the Edwards and associated limestones, San Antonio area, Texas, 1975. This report will be published as a bulletin of the Edwards Underground Water District.

Analytical or Interpretive Reports

County Ground-Water Appraisal Reports

Ground-water resources of Grimes County, Texas. This report was published as Texas Water Development Board report 186.

Ground-water resources of Colorado, Lavaca, and Wharton Counties, Texas. This report will be published as a Texas Water Development Board report.

Other Analytical or Interpretive Reports

Analog-model studies of ground-water hydrology in the Houston district, Texas. This report was published as Texas Water Development Board report 190.

Floods of September - October 1967 in south Texas and northeastern Mexico. This report was published as U.S. Geological Survey Water-Supply Paper 1880-B.

Land-surface subsidence in the Houston-Galveston region, Texas. This report was published as Texas Water Development Board report 188.

Relation of precipitation to ground-water recharge in the San Antonio area, Texas. This report was released as a U.S. Geological Survey open-file report.

Simulated water-level changes resulting from proposed changes in ground-water pumping in the Houston, Texas, area. This report was released as a U.S. Geological Survey open-file report.

Time-of-travel of solutes in the Trinity River, Texas, September 1973 and July-August 1974. This report was released as a U.S. Geological Survey open-file report.

Artificial recharge in farm management of irrigation supplies on the Southern High Plains of Texas and New Mexico. This report will be published as a Texas Water Development Board report.

Delineation of the Miocene aquifers in the Gulf Coastal region of Texas. This report will be published as a Texas Water Development Board report.

Digital-model study of ground-water development in the Hueco Bolson near El Paso, Texas. This report will be published as a U.S. Geological Survey Water-Resources Investigations report.

Earth resistivity and hydrogeology of the El Paso Valley, Texas. This report will be published as a Texas Water Development Board report.

Earth resistivity and hydrogeology of the Lower Mesilla Valley, Texas and New Mexico. This report will be published as a Texas Water Development Board report.

Evaluation of fresh ground water in the basins of westernmost Texas. This report will be published as A Texas Water Development Board report.

Land-surface subsidence at Seabrook, Texas. This report was released to the open file and will be published as a U.S. Geological Survey Water-Resources Investigations report.

Land-surface subsidence in the area of Moses Lake near Texas City, Texas. This report was released to the open file and will be published as a U.S. Geological Survey Water-Resources Investigations report.

Porosity studies of the Edwards aquifer, San Antonio area, Texas. This report will be published as a Texas Water Development Board report.

Summary appraisals of the Nation's ground-water resources--Texas-Gulf region. This report will be published as a U.S. Geological Survey Professional Paper.

Test drilling for ground water in Hudspeth, Culberson, and Presidio Counties, Texas. This report will be published as a Texas Water Development Board report.

Bibliographic Reports

Annotated bibliography of water-resources publications and open-file reports for Texas by the Texas Water Development Board and the U.S. Geological Survey through September 1974. This report will be published as a Texas Water Development Board report.

Bibliography of U.S. Geological Survey reports on the geology and water resources of Texas, 1887-1974. This report was published as U.S. Geological Survey Water-Resources Investigations report WRI 20-75.

MAPS OF FLOOD-PRONE AREAS IN TEXAS

These maps show the approximate boundaries of the areas subject to inundation by a 100-year flood, which means that on the average, there is about 1 chance in 100 that the delineated areas will be flooded in any year. The names listed under "quadrangle" indicate the name assigned by the U.S. Geological Survey.

Quadrangle	County
Albany	Shackelford
Alvarado	Johnson
Atlanta North	Cass, Bowie
Atlanta South	Cass
Baileyboro Northeast	Bailey
Bandera	Bandera
Barwise	Floyd, Hale
Benavides	Duval
Ben Bolt Northwest	Duval, Jim Wells
Blanco	Blanco, Kendall
Bloomington	Victoria
Borger	Hutchinson
Bowie	Montague
Breckenridge	Stephens
Brownfield West	Terry
Brownsville East	Cameron
Brownsville West	Cameron
Cactus East	Moore, Sherman
Cactus West	Moore, Sherman
Cameron	Milam
Camilla	Polk, San Jacinto
Canton	Van Zandt
Carrizo Springs Northeast	Dimmit, Zavala
Celeste	Hunt, Fannin
Celina	Collin, Denton
Center Point	Kerr
Childress	Childress
Cisco North	Eastland
Cisco South	Eastland
Clarendon	Donley
Coldspring	San Jacinto
Comanche	Comanche
Comfort	Kendall, Kerr
Copperas Cove	Coryell, Bell, Burnet, Lampasas
Courtney	Grimes, Washington
Cranfills Gap	Bosque, Hamilton
Crockett	Houston
Crosbyton	Crosby
Cuero	De Witt
Cut and Shoot	Montgomery
Cypress	Harris
Daingerfield	Cass, Marion
De Kalb, Tex.-Okla.	Bowie
De Leon	Comanche
Deport	Red River, Lamar
D'Hanis	Medina
Diboll	Angelina, Polk, Trinity
Dimmitt	Castro
Driftwood	Hays
Driskoll East	Nueces
Dublin	Erath, Comanche
Dumas North	Moore
Dumas South	Moore
Eagle Lake	Wharton, Colorado
East Bernard	Fort Bend, Wharton, Austin
Eastland	Eastland
Edgewood	Van Zandt
El Campo	Wharton
Electra	Wilbarger, Wichita
Falls City	Karnes, Wilson
Florence	Williamson, Burnet
Floydada	Floyd
Floydada Southeast	Crosby, Floyd

Quadrangle	County
Fort Sotckton East	Pecos
Fort Stockton West	Pecos
Fostoria	Liberty, Montgomery, San Jacinto
Fredericksburg East	Gillespie
Fredericksburg West	Gillespie
Frisco	Collin, Denton
Fulshear	Fort Bend, Waller
Ganado	Jackson
Garwood	Colorado, Wharton
George West	Live Oak
Giddings	Lee
Gilmer	Upshur
Glen Rose East	Bosque, Somervell
Glen Rose West	Bosque, Somervell
Gober	Fannin, Hunt
Gonzales North	Gonzales
Gonzales South	Gonzales
Graham	Young
Grandfalls	Crane, Pecos, Ward
Greenville Southwest	Hunt
Gustine	Comanche
Hale Center	Hale
Hargill	Hidalgo
Harlingen	Cameron
Haskell	Haskell
Hebbronville	Jim Hogg, Duval
Hereford	Deaf Smith
Hilltop Lakes	Leon, Madison
Hodgson	Bowie, Red River
Hondo	Medina
Hunt	Kerr
Jefferson	Marion
Juliff	Brazoria, Fort Bend
Karnes City	Karnes
Katy	Fort Bend, Waller
Kerrville	Kerr
La Feria	Cameron, Hidalgo
Lake Olney	Archer, Young
La Leona	Cameron, Willacy
La Paloma	Cameron
Lefors	Gray
Legion	Kerr
Lelia Lake	Donley
Liberty	Liberty
Lolita	Jackson
Longworth	Fisher
Los Fresnos	Cameron
Lorenzo	Lubbock, Crosby
Mabank	Henderson, Kaufman, Van Zandt
Madisonville	Madison
Malakoff	Henderson, Navarro
Malta	Bowie
Manvel	Brazoria
Marble Falls	Burnet, Llano
Marshall West	Harrison
Mason	Mason
Maud	Bowie, Cass
McLean	Wheeler, Collingsworth, Donley, Gray
Menard	Menard
Meridian	Bosque
Monahans	Ward
Moulton	Gonzales, Lavaca
Muleshoe	Bailey
Munday East	Knox, Haskell
Munday West	Knox, Haskell
Myrtle Springs	Van Zandt
Naples	Cass, Morris
Navasota	Brazos, Grimes
Nocona	Montague

Quadrangle	County
Nolanville	Bell
Normangee	Madison, Leon
Oak Grove	Bowie, Red River
Oakwood	Anderson, Leon, Freestone
Olmito	Cameron
Olney	Young
Orchard	Fort Bend
Palmer	Ellis
Pampa	Gray, Roberts
Pasadena	Harris
Pecos East	Reeves
Pecos West	Reeves
Petersburg	Floyd, Crosby, Lubbock, Hale
Phillips	Hutchinson
Post East	Garza
Post West	Garza
Poth	Karnes, Wilson
Premont East	Brooks, Jim Wells, Kleberg
Premont West	Jim Wells, Brooks, Duval
Progress	Parmer, Bailey
Purdy Hill	Mason
Pyote East	Ward
Pyote West	Ward
Ralls Northeast	Crosby
Ranger	Eastland
Rankin	Upton
Raymondville	Hidalgo, Willacy
Realitos	Duval
Richmond	Fort Bend
Richmond Northeast	Fort Bend
Rio Grande City North	Starr
Rio Grande City South	Starr
Rio Hondo	Cameron
Roby	Fisher
Rockdale East	Milam
Rockdale West	Milam
Roma-Los Saenz East	Starr
Roma-Los Saenz West	Starr
Rosharon	Brazoria
Rotan	Fisher
Royse City	Rockwall, Collin
Royston	Fisher
Salado	Bell
Sanderson	Terrell
San Diego	Duval, Jim Wells
Santa Maria	Cameron, Hidalgo
Santa Rosa	Cameron, Willacy, Hidalgo
Seymour East	Baylor
Seymour West	Baylor
Somerville	Burleson, Washington
Spearman	Hansford
Springtown	Parker, Wise
Stinnett	Hutchinson
Stockdale	Wilson
Stowell	Chambers
Sundown	Hockley, Terry
Sweetwater	Nolan
Tahoka	Lynn
Tilden	McMullen
Tool	Henderson, Kaufman
True	Young
Tule Lake	Swisher
Tuleta	Bee
Tulsita	Karnes, Goliad, Bee
Turkey	Briscoe, Hall
Twin Mountains	Coryell, Lampasas
Van	Van Zandt

Quadrangle	County	Quadrangle	County
Van Horn	Culberson	Wimberley	Comal, Hays
Waelder	Fayette, Gonzales	Wink South	Ward, Winkler
Wallis	Fort Bend, Austin, Waller	Winnsboro	Wood, Hopkins, Franklin
Wasson	Hale	Wolfe City	Hunt
Wellington	Collingsworth	Woodlawn	Harrison, Marion
Westcott	San Jacinto, Liberty	Yoakum	Lavaca, De Witt
Wellamar Southwest	Cameron, Willacy	Yorktown East	De Witt, Goliad
Wills Point	Van Zandt, Kaufman	Yorktown West	De Witt

SELECTED LIST OF AVAILABLE REPORTS OF GENERAL INTEREST 1/

U.S. Geological Survey Circular 460-E: Water quality of hydrologic bench marks--An indicator of water quality in the natural environment, by J. E. Biesecker and D. K. Leifeste. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 601-E: Sediment problems in urban areas, by H. P. Guy. Free on application to the U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 601-K: An introduction to the processes, problems, and management of urban lakes, by L. J. Britton, R. C. Averett, and R. F. Ferreira. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 719: The National Stream Quality Accounting Network (NASQAN)--Some questions and answers, by J. F. Ricke and R. O. Hawkinson. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Circular 726: Assessment of geothermal resources of the United States--1975, by D. E. White and D. L. Williams. Free on application to U.S. Geological Survey, Reston, Virginia 22092

U.S. Geological Survey Professional Paper 708: Ground-water hydraulics, by S. W. Lohman. Available from U.S. Geological Survey Public Inquiries Office - $4.15

U.S. Geological Survey Professional Paper 813-D: Summary appraisals of the Nation's ground-water resources--Rio Grande region, by S. W. West and W. L. Broadhurst. Available from U.S. Geological Survey Public Inquiries Office - $5.70

U.S. Geological Survey Professional Paper 837: The logic of geological maps with reference to their interpretation and use for engineering purposes, by D. J. Varnes. Available from U.S. Geological Survey Public Inquiries Office - $3.50

U.S. Geological Survey Professional Paper 900: Geological Survey Research 1974. Available from U.S. Geological Survey Public Inquiries Office - $6.10

U.S. Geological Survey Water-Supply Paper 1880-B: Floods of September-October 1967 in south Texas and northeastern Mexico, by E. E. Schroeder, R. U. Grozier, D. C. Hahl, and A. E. Hulme. Available from U.S. Geological Survey Public Inquiries Office - $3.55

U.S. Geological Survey Water-Supply Paper 2029-E: An appraisal of potential water salvage in the Lake McMillan delta area, Eddy County, New Mexico, by E. R. Cox and J. S. Havens. Available from U.S. Geological Survey Public Inquiries Office - $1.50

U.S. Geological Survey Water-Supply Paper 2097: Quality of surface waters of the United States, 1968--Part 8, Western Gulf of Mexico basins. Available from U.S. Geological Survey Public Inquiries Office - $3.45

U.S. Geological Survey Water-Supply Paper 2120: Surface water supply of the United States, 1966-70--Part 7, Lower Mississippi River basin--Volume 1, Lower Mississippi River basin except Arkansas River basin. Available from U.S. Geological Survey Public Inquiries Office - $9.60

U.S. Geological Survey Water-Supply Paper 2121: Surface water supply of the United States, 1966-70--Part 7, Lower Mississippi River basin--Volume 2, Arkansas River basin. Available from U.S. Geological Survey Public Inquiries Office - $6.15

U.S. Geological Survey Water-Supply Paper 2122: Surface water supply of the United States, 1966-70--Part 8, Western Gulf of Mexico basins--Volume 1, Basins from Mermentau River to Colorado River. Available from U.S. Geological Survey Public Inquiries Office - $8.75

U.S. Geological Survey Water-Supply Paper 2123: Surface water supply of the United States, 1966-70--Part 8, Western Gulf of Mexico basins--Volume 2, Basins from Lavaca River to Rio Grande. Available from U.S. Geological Survey Public Inquiries Office - $5.70

U.S. Geological Survey Water-Supply Paper 2146: Quality of surface waters of the United States, 1969--Part 7, Lower Mississippi River basin. Available from U.S. Geological Survey Public Inquiries Office - $3.85

U.S. Geological Survey Water-Supply Paper 2147: Quality of surface waters of the United States, 1969--Part 8, Western Gulf of Mexico basin. Available from U.S. Geological Survey Public Inquiries Office - $4.00

U.S. Geological Survey Water-Supply Paper 2156: Quality of surface waters of the United States, 1970--Part 7, Lower Mississippi River basin. Available from U.S. Geological Survey Public Inquiries Office - $5.25

U.S. Geological Survey Water-Supply Paper 2157: Quality of surface waters of the United States, 1970--Part 8, Western Gulf of Mexico basins. Available from Geological Survey Public Inquiries Office - $4.50

SUMMARY OF COOPERATION

Organizations assisting in collecting data under cooperative agreements with the Geological Survey are:

Texas Water Development Board. Charles Nemir, Acting Executive Director; A. L. Black, Chairman; Robert B. Gilmore, Vice-Chairman; Milton T. Potts, W. E. Tinsley, John H. Garrett, and George W. McCleskey, Members.

Texas Department of Highways and Public Transportation. B. L. DeBerry, Engineer-Director; Reagan Houston, Chairman; Charles E. Simons and Dewitt C. Greer, Members.

Pecos River Commission. Horace M. Babcock, Commissioner representing the United States and Chairman; R. B. McGowen, Jr., Commissioner representing Texas; and John B. Walker, Commissioner representing New Mexico.

Sabine River Compact Administration. W. H. Robinson, Commissioner representing the United States and Chairman; R. J. Palmer and H. B. Myers for Louisiana; and J. M. Syler and George Smith for Texas.

County of Dallas. C. Judson Shook, Jr., Director of Public Works.

City of Austin. Charles B. Graves, Jr., Director of Engineering.

City of Dallas. Monroe McCorkle, Director of Public Works.

City of Fort Worth. Jack M. Graham, Director of Public Works.

City of Houston. E. B. Cape, Director of Public Works.

1/ For publications available from U.S. Geological Survey Public Inquiries Office, order should be addressed to: U.S. Geological Survey Public Inquiries Office, Room 1 C 45, 1100 Commerce Street, Dallas, Texas 75201.

Assistance in the form of funds or services is furnished by the following Federal agencies:

Department of Housing and Urban Development.

Environmental Protection Agency.

International Boundary and Water Commission, United States and Mexico, U.S. Section.

National Aeronautics and Space Administration.

Soil Conservation Service, Department of Agriculture.

U.S. Army, Corps of Engineers, Albuquerque District, New Mexico.

U.S. Army, Corps of Engineers, Fort Worth District, Texas.

U.S. Army, Corps of Engineers, Galveston District, Texas.

U.S. Army, Corps of Engineers, Little Rock District, Arkansas.

U.S. Army, Corps of Engineers, New Orleans District, Louisiana.

U.S. Army, Corps of Engineers, Tulsa District, Oklahoma.

Assistance in the form of funds or services is rendered by the following organizations through the Texas Water Development Board:

Cities

Abilene	Clyde	Galveston
Alice	Corpus Christi	Graham
Arlington	Dallas	Houston
Austin	El Paso	San Angelo
Brady	Gainesville	Wichita Falls
Cleburne		

Other Cooperators

Athens Municipal Water Authority

Bexar-Medina-Atascosa Counties Water Improvement District No. 1

Bistone Municipal Water Supply District

Brazos River Authority

Chocolate Bayou Company

Colorado River Municipal Water District

Dallas County

Dallas Power and Light Company

Dayton Canal Company

Dow Chemical Company

Edwards Underground Water District

Franklin County Water District

Freese and Nichols

Greenbelt Municipal and Industrial Water Authority

Guadalupe-Blanco River Authority

Harris County Flood Control District

Harris-Galveston Coastal Subsidence District

Houston Lighting and Power Company

Lone Star Steel Company

Lower Colorado River Authority

Lower Neches Valley Authority

Mackenzie Municipal Water Authority

North Central Texas Municipal Water Authority

Northeast Texas Municipal Water District

Palo Pinto County Municipal Water District No. 1

Red Bluff Water Power Control District

Reeves County Water Improvement District No. 1

Richmond Rice Association

Sabine River Authority of Texas

San Antonio City Public Service Board

San Antonio City Water Board

San Antonio River Authority

San Jacinto River Authority

Tarrant County Water Control and Improvement District No. 1

Texas Electric Service Company

Texas Utilities Services Inc.

The Woodlands Development Corporation

Tom Green County Water Control and Improvement District No. 1

Trinity River Authority

Upper Guadalupe River Authority

Upper Neches River Municipal Water Authority

West Central Texas Municipal Water District

White River Municipal Water District

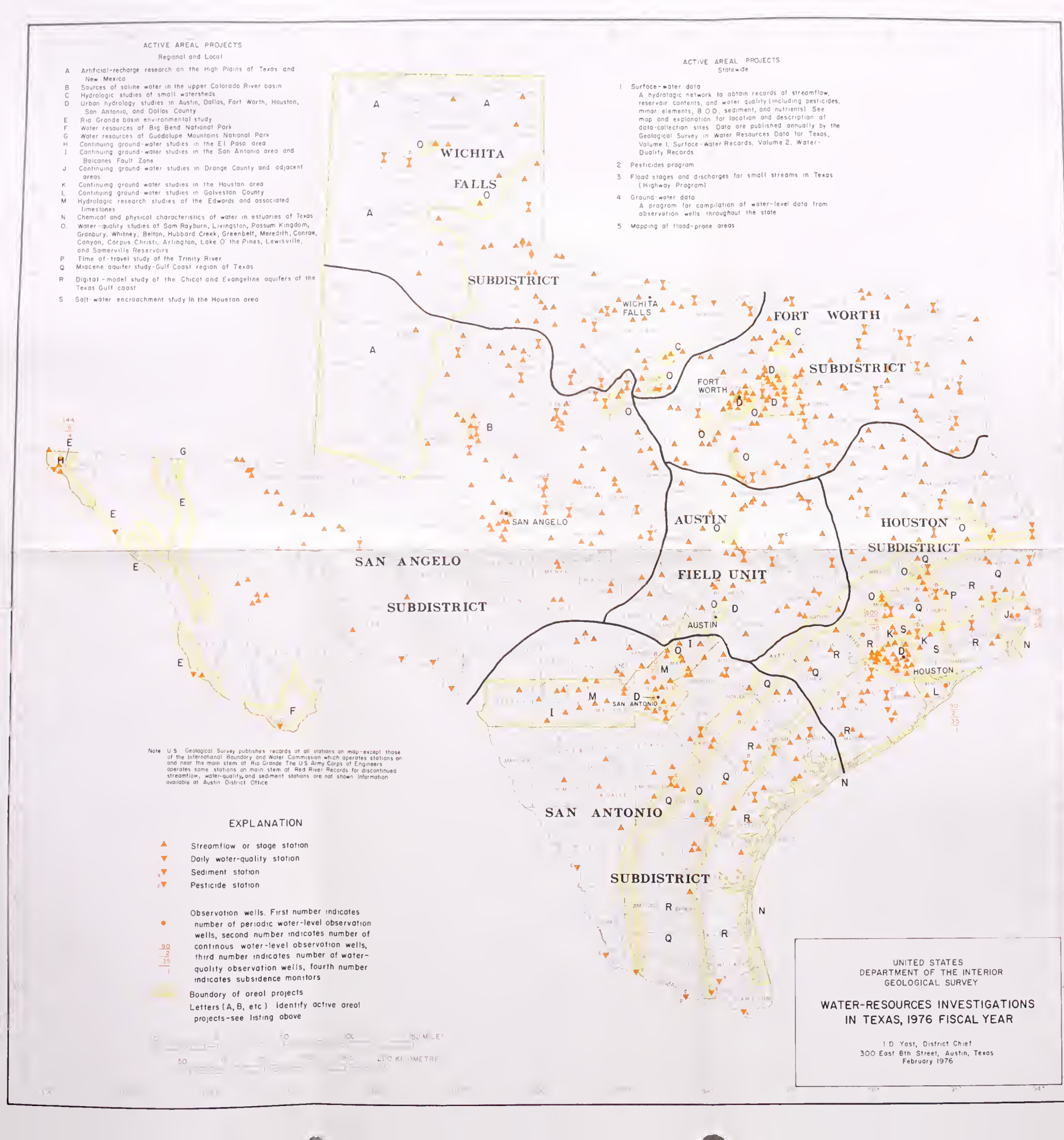
Wichita County Water Improvement District No. 2

Wood County

ACTIVE AREAL PROJECTS

Regional and Local

A. Artificial-recharge research on the High Plains of Texas and New Mexico
B. Sources of saline water in the upper Colorado River basin
C. Hydrologic studies of small watersheds
D. Urban hydrology studies in Austin, Dallas, Fort Worth, Houston, San Antonio, and Dallas County
E. Rio Grande basin environmental study
F. Water resources of Big Bend National Park
G. Water resources of Guadalupe Mountains National Park
H. Continuing ground-water studies in the El Paso area
I. Continuing ground-water studies in the San Antonio area and Balcones Fault Zone
J. Continuing ground-water studies in Orange County and adjacent areas
K. Continuing ground-water studies in the Houston area
L. Continuing ground-water studies in Galveston County
M. Hydrologic research studies of the Edwards and associated limestones
N. Chemical and physical characteristics of water in estuaries of Texas
O. Water-quality studies of Sam Rayburn, Livingston, Possum Kingdom, Granbury, Whitney, Belton, Hubbard Creek, Greenbelt, Meredith, Conroe, Canyon, Corpus Christi, Arlington, Lake O' the Pines, Lewisville, and Somerville Reservoirs
P. Time-of-travel study of the Trinity River
Q. Miocene aquifer study-Gulf Coast region of Texas
R. Digital-model study of the Chicot and Evangeline aquifers of the Texas Gulf coast
S. Salt-water encroachment study in the Houston area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ACTIVE AREAL PROJECTS
Statewide
1 Surface-water data
A hydrologic network to obtain records of streamflow, reservoir contents, and water quality (including pesticides, minor elements, B.O.D., sediment, and nutrients) See map and explanation for location and description of data-collection sites Data are published annually by the Geological Survey in Water Resources Data for Texas, Volume 1, Surface-Water Records, Volume 2, Water-Quality Records
2 Pesticides program
3 Flood stages and discharges for small streams in Texas (Highway Program)
4 Ground-water data
A program for compilation of water-level data from observation wells throughout the state
5 Mapping of flood-prone areas
WICHITA FALLS SUBDISTRICT
FORT WORTH SUBDISTRICT
AUSTIN FIELD UNIT
HOUSTON SUBDISTRICT
SAN ANGELO SUBDISTRICT
SAN ANTONIO SUBDISTRICT
WICHITA FALLS
FORT WORTH
AUSTIN
HOUSTON
SAN ANGELO
SAN ANTONIO
Note U.S. Geological Survey publishes records at all stations on map-except those of the International Boundary and Water Commission which operates stations on and near the main stem at Rio Grande The U.S. Army Corps of Engineers operates some stations on main stem at Red River Records for discontinued streamflow, water-quality, and sediment stations are not shown Information available at Austin District Office
EXPLANATION
Streamflow or stage station
Daily water-quality station
Sediment station
Pesticide station
Observation wells. First number indicates number of periodic water-level observation wells, second number indicates number of continous water-level observation wells, third number indicates number of water-quality observation wells, fourth number indicates subsidence monitors
Boundary of areal projects
Letters (A, B, etc.) identify active areal projects-see listing above
0 50 100 150 MILES
0 50 100 200 KILOMETRES
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER-RESOURCES INVESTIGATIONS IN TEXAS, 1976 FISCAL YEAR
I D Yost, District Chief
300 East 8th Street, Austin, Texas
February 1976

UNIVERSITY OF ILLINOIS-URBANA
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